




SYSTEMATIC REVIEW

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# Ethnic disparities in the prevalence of prediabetes and diabetes in Australia: a systematic review and meta-analysis

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## Abstract

**Background** Ethnicity plays a significant role in the prevalence of prediabetes and diabetes, yet no systematic review has explored this in Australia.

**Objective** This study aims to systematically review and meta-analyse ethnic differences in the prevalence of diabetes and prediabetes in Australia.

**Method** In July–August 2024, a comprehensive search of cross-sectional and observational studies published between 2010 and 2024 in MEDLINE, EMBASE, Scopus, CINAHL, and Web of Science was conducted. Studies that reported the prevalence of diabetes and prediabetes in adults from various ethnic groups in Australia were included, while those focused on pregnant women and individuals under 18 were excluded. In STATA, 'metaprop' and 'metapreg' were used to estimate each indicator's prevalence and assess across different subgroups.

**Results** Of 2,838 studies, 27 studies involving 1,137,925 participants were included. In 46.2% of studies, diabetes diagnoses were based on self-reported data. The pooled weighted prevalence was 21.8% (95% CI: 20.60–23.01) for diabetes and 13.7% (CI: 10.42–17.02) for prediabetes. Pacific people (36.5%, CI: 15.20–57.86) and Indigenous Australians (30.7%, CI: 23.90–37.49) had the highest pooled weighted prevalence of diabetes, while White/People of European descent (14.5%, CI: 13.03–16.01) and non-Indigenous Australians (18.6%, CI: 20.83–23.24) had the lowest prevalence of diabetes. There were significant heterogeneity ( $I^2 = 99.9\%$ ,  $p < 0.05$ ) among the reviewed studies.

**Conclusion** Diabetes and prediabetes are highly prevalent in Australia, with marked disparities across ethnic groups. Pacific people and Indigenous Australians had the the highest burden of both conditions, highlighting the need for targeted, culturally appropriate interventions. Future research exploring the underlying causes of these disparities and the effectiveness of tailored prevention strategies are warranted.

**Keywords** Prevalence, Diabetes, Prediabetes, Ethnic disparities, Immigrants, Australia

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## Background

Prediabetes and diabetes are chronic diseases of significant public health importance due to their profound impact on global morbidity and mortality rates [1, 2]. According to the World Health Organization (WHO) and the American Diabetes Association (ADA), diabetes is diagnosed when fasting plasma glucose is  $\geq 7.0$  mmol/L (126 mg/dL), 2-h plasma glucose is  $\geq 11.1$  mmol/L (200 mg/dL) during an oral glucose tolerance test (OGTT), or HbA1c is  $\geq 6.5\%$  [3, 4]. Prediabetes is defined as fasting plasma glucose between 5.6–6.9 mmol/L (100–125 mg/dL), 2-h OGTT values between 7.8–11.0 mmol/L (140–199 mg/dL), or HbA1c between 5.7% and 6.4% [3, 4]. These conditions exert a profound impact on public health beyond individual well-being. Globally, they account for approximately 67.9 million disability-adjusted life years and cause 1.37 million deaths annually [5]. These conditions account for approximately 67.9 million disability-adjusted life years and 1.37 million deaths annually worldwide [3], and the global economic burden continues to grow—from USD 760 billion in 2019 to \$966 billion in 2021, with projections to exceed \$1.05 trillion by 2045 [6, 7]. In 2021, an estimated 537 million adults globally were living with diabetes, up from 463 million in 2019, and this figure is projected to rise to 853 million by 2050. The highest prevalence rates are observed in the Middle East and North Africa (MENA) and the Pacific peoples [5, 8].

Globally, the prevalence of diabetes and prediabetes varies significantly by ethnicity. Indigenous populations and individuals of South Asian, Middle Eastern, and Hispanic descent have been shown to have a 25% higher risk of developing diabetes or progressing from prediabetes compared to White/People of European descent [7, 9, 10]. Regionally, North Americans and Caribbeans have the highest recorded prevalence of prediabetes based on impaired glucose tolerance (IGT), whereas Southeast Asians report the lowest prevalence. Additionally, South and Central America, as well as the Western Pacific, show lower prevalence rates [12]. Furthermore, immigrants to the USA and Europe from Latin America, Sub-Saharan Africa, North Africa, and the Middle East demonstrate higher prevalence rates of prediabetes and diabetes compared to those from Western European countries [2, 11]. In the UK, diabetes prevalence has been reported to be three to six times higher among Black Caribbeans, Indians, Pakistanis, and Bangladeshis than among White British populations [13]. Similar disparities have been reported across other European contexts [14].

In Australia, approximately 1.2 million individuals (5.1% of the population) were living with diagnosed diabetes in 2022. Furthermore, one in every six adults over the age of 25 years is estimated to have either prediabetes or diabetes [15, 16]. Ethnic disparities are evident

in Australian prevalence studies: 4.2%–12.3% among Southeast Asians, 7.3%–18.4% among South and Central Asians, 5.4%–12.3% among individuals from the MENA region, and around 6.3% among White/People of European descent. The highest prevalence rates were observed in Pacific peoples (17.4%) and First Nations Australians, where estimates ranged from 3.5% to 33.1% [17, 18].

While ethnicity is widely recognized as a key determinant of diabetes and prediabetes prevalence in other high-income, multicultural countries such as the USA [6], Canada [11], and across Europe [2, 13, 14, 19] Australia lacks a consolidated evidence base reflecting this reality. Although several individual studies have examined ethnic disparities in diabetes and prediabetes prevalence in Australia, no systematic review has been done to synthesize these findings or produce pooled prevalence estimates by ethnic group. Given Australia's highly diverse population, including people of Sub-Saharan African, Pacific people, Asian, Middle Eastern, Hispanic/Latina, and European descent, and its role as a major migrant destination, there is a clear need to consolidate existing data. This systematic review and meta-analysis aim to address that gap by examining ethnic disparities in the prevalence of diabetes and prediabetes in Australia.

## Method

### Study design

The systematic review and meta-analysis were conducted on studies in Australia involving different ethnic groups. The reporting of this study followed the recommendations outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement and guided by the methodology as described by Rudnicka and Owen [20]. The protocol for this systematic review and meta-analysis was registered in the Prospective Register of Systematic Reviews (PROSPERO; registration number: CRD42024576039).

### Outcome variables

The outcome variables were diabetes and prediabetes defined based on the World Health Organization and/or American Diabetes Association guidelines which is used in Australia to provide evidence on the proportion of people living in Australia with these conditions by their ethnicity.

### Search strategy

The full search strategy used in this study has been presented in Table 1. It involved three steps: step one involved a manual search for systematic reviews on the prevalence of diabetes and prediabetes among different ethnic groups in Australia; step two involved using the Population/Problem/Patient, Exposure, Outcome (PEO) Population: adults in different ethnic groups, Exposure:

**Table 1** Full Search strategy

Database searched	Terms used	Date searched
Scopus	(TITLE-ABS (prediabet* OR diabet* OR hyperglycem* OR high blood sugar* OR nidd OR t2d OR ((impair* OR toleran* OR disregulat* OR impaired fasting* OR intoleran* OR abnormal*) W/2 glucose))) AND (TITLE-ABS (prevalen* OR inciden* OR epidemiolog* OR frequency OR occurrence* OR regularit*)) AND (TITLE-ABS (ethnic* OR race* OR nationalit* OR origin* OR tribe* OR minorit* OR cultur* OR migrant* OR immigrant* OR country of birth* OR country of origin* OR Torres Island** OR aboriginal* OR first nation** OR indigenous)) AND (TITLE-ABS (australia OR New South Wales* OR victoria OR South Australia* OR Western Australia* OR tasmania OR queensland OR Northern Territory* OR Australian Capital Territory* OR sydney OR melbourne OR darwin OR adelaide OR brisbane OR perth OR canberra OR hobart))	18/08/2024
CINAHL	((TI prediabet* OR AB prediabet* OR TI diabet* OR AB diabet* OR TI hyperglycem* OR AB hyperglycem* OR TI high blood sugar* OR AB high blood sugar* OR TI nidd OR AB nidd OR TI t2d OR AB t2d OR TI (impair* N2 glucose) OR AB (impair* N2 glucose) OR TI (toleran* N2 glucose) OR AB (toleran* N2 glucose) OR TI (disregulat* N2 glucose) OR AB (disregulat* N2 glucose) OR TI impaired fasting* OR AB impaired fasting* OR TI intoleran* OR AB intoleran* OR TI abnormal* OR AB abnormal*) AND (TI prevalen* OR AB prevalen* OR TI inciden* OR AB inciden* OR TI epidemiolog* OR AB epidemiolog* OR TI frequency OR AB frequency OR TI occurrence* OR AB occurrence* OR TI regularit* OR AB regularit*) AND (TI ethnic* OR AB ethnic* OR TI race* OR AB race* OR TI nationalit* OR AB nationalit* OR TI origin* OR AB origin* OR TI tribe* OR AB tribe* OR TI minorit* OR AB minorit* OR TI cultur* OR AB cultur* OR TI migrant* OR AB migrant* OR TI immigrant* OR AB immigrant* OR TI country of birth* OR AB country of birth* OR TI country of origin* OR AB country of origin* OR TI Torres Island** OR AB Torres Island** OR TI aboriginal* OR AB aboriginal* OR TI first nation** OR AB first nation** OR TI indigenous OR AB indigenous) AND (TI australia OR AB australia OR TI New South Wales* OR AB New South Wales* OR TI victoria OR AB victoria OR TI South Australia* OR AB South Australia* OR TI Western Australia* OR AB Western Australia* OR TI tasmania OR AB tasmania OR TI queensland OR AB queensland OR TI Northern Territory* OR AB Northern Territory* OR TI Australian Capital Territory* OR AB Australian Capital Territory* OR TI sydney OR AB sydney OR TI melbourne OR AB melbourne OR TI darwin OR AB darwin OR TI adelaide OR AB adelaide OR TI brisbane OR AB brisbane OR TI perth OR AB perth OR TI canberra OR AB canberra OR TI hobart OR AB hobart))	6/08/2024
Web of science	TS=(prediabet* OR diabet* OR hyperglycem* OR high blood sugar* OR nidd OR t2d OR ((impair* OR toleran* OR disregulat* OR impaired fasting* OR intoleran* OR abnormal*) NEAR/2 glucose)) AND TS=(prevalen* OR inciden* OR epidemiolog* OR frequency OR occurrence* OR regularit*) AND TS=(ethnic* OR race* OR nationalit* OR origin* OR tribe* OR minorit* OR cultur* OR migrant* OR immigrant* OR country of birth* OR country of origin* OR Torres Island** OR aboriginal* OR first nation** OR indigenous) AND TS=(australia OR New South Wales* OR victoria OR South Australia* OR Western Australia* OR tasmania OR queensland OR Northern Territory* OR Australian Capital Territory* OR sydney OR melbourne OR darwin OR adelaide OR brisbane OR perth OR canberra OR hobart)	18/07/2024
Medline	(prediabet*[tiab] OR diabet*[tiab] OR hyperglycem*[tiab] OR high blood sugar*[tiab] OR nidd[tiab] OR t2d[tiab] OR ((impair*[tiab] OR toleran*[tiab] OR disregulat*[tiab] OR impaired fasting*[tiab] OR intoleran*[tiab] OR abnormal*[tiab]) AND glucose[tiab])) AND (prevalen*[tiab] OR inciden*[tiab] OR epidemiolog*[tiab] OR frequency[tiab] OR occurrence*[tiab] OR regularit*[tiab]) AND (ethnic*[tiab] OR race*[tiab] OR nationalit*[tiab] OR origin*[tiab] OR tribe*[tiab] OR minorit*[tiab] OR cultur*[tiab] OR migrant*[tiab] OR immigrant*[tiab] OR country of birth*[tiab] OR country of origin*[tiab] OR Torres Island**[tiab] OR aboriginal*[tiab] OR first nation**[tiab] OR indigenous[tiab]) AND (australia[tiab] OR New South Wales*[tiab] OR victoria[tiab] OR South Australia*[tiab] OR Western Australia*[tiab] OR tasmania[tiab] OR queensland[tiab] OR Northern Territory*[tiab] OR Australian Capital Territory*[tiab] OR sydney[tiab] OR melbourne[tiab] OR darwin[tiab] OR adelaide[tiab] OR brisbane[tiab] OR perth[tiab] OR canberra[tiab] OR hobart[tiab])	14/07/2024
EMBASE	'diabetes mellitus'/exp OR prediabet*:ti,ab OR diabet*:ti,ab OR hyperglycem*:ti,ab OR high blood sugar':ti,ab OR niddm:ti,ab OR t2d:ti,ab OR ((impair* OR toleran* OR disregulat* OR impaired fasting* OR intoleran* OR abnormal*) NEAR/2 glucose):ti,ab AND epidemiology'/exp OR prevalen*:ti,ab OR inciden*:ti,ab OR epidemiolog*:ti,ab OR frequency:ti,ab OR occurrence*:ti,ab OR regularit*:ti,ab AND ethnic group'/exp OR ethnic*:ti,ab OR race*:ti,ab OR nationalit*:ti,ab OR origin*:ti,ab OR tribe*:ti,ab OR minorit*:ti,ab OR cultur*:ti,ab OR migrant*:ti,ab OR immigrant*:ti,ab OR country of birth':ti,ab OR country of origin':ti,ab OR Torres Island*':ti,ab OR aboriginal*:ti,ab OR first nation*':ti,ab OR indigenous:ti,ab AND australia'/exp OR australia:ti,ab OR new south wales':ti,ab OR victoria:ti,ab OR south australia':ti,ab OR western australia':ti,ab OR tasmania:ti,ab OR queensland:ti,ab OR northern territory':ti,ab OR australian capital territory':ti,ab OR sydney:ti,ab OR melbourne:ti,ab OR darwin:ti,ab OR adalidet:ti,ab OR brisbane:ti,ab OR perth:ti,ab OR canberra:ti,ab OR hobart:ti,ab	14/07/2024

diabetes and prediabetes, Outcome: prevalence, Context: Australia) criteria to devise the search terms. In the last step, a comprehensive literature search was conducted to identify relevant articles on diabetes and prediabetes in different ethnic groups in Australia published over the years (2010–2024). The following databases were searched: PubMed/MEDLINE, Excerpta Medica Database (EMBASE), Scopus, Cumulative Index to Nursing and Allied Health Literature.(CINAHL), and Web of

Science. A predefined search strategy, utilizing a combination of pertinent terms, was employed. Both free-text keywords and medical subject headings were incorporated, including “diabetes,” “prediabetes,” “glucose intolerance,” “impaired fasting glucose,” “impaired glucose tolerance,” “prevalence,” “ethnicity,” and “Australia.” These terms and their variants were used in various combinations, with the search strategy adapted for each specific database.

The literature search was conducted between June and August, 2024, with a time filter applied for articles published from 2010 to 2024. The search commenced in PubMed/MEDLINE, after which the same search terms were utilized in the other databases. Specific search terms included variations of diabetes (e.g., Type 2 diabetes, non-insulin-dependent diabetes, NIDD, Type II diabetes, T2D); prediabetes (e.g., impaired glucose tolerance [IGT], glucose intolerance, glucose abnormalities); prevalence: (e.g., epidemiology, incidence, frequency, distribution, occurrence); ethnicity: (e.g., Aboriginal and Torres Strait Islander people, Indigenous people, First Nations, Indigenous Australian, Aboriginal, Native people, First Australian, Torres Strait Islander, Africans, Sub-Saharan Africans, Europeans, White/People of European descent, Hispanics, Asians, Pacific peoples, Caribbeans, Latin Americans, Anglo-Celtic, North Africa and Middle East, and Australia (e.g., New South Wales, Queensland, South Australia, Tasmania, Victoria, Western Australia, Australian Capital Territory, Sydney, Brisbane, Melbourne, Perth, Adelaide, Gold Coast, Central Coast).

To identify additional potential sources, the reference lists of eligible articles and relevant reviews were manually searched (a method known as snowballing). Selected articles were retrieved and managed using Covidence, which facilitated reference management and the removal of duplicate entries.

### Eligibility criteria

The inclusion and exclusion criteria for this review were developed using the PEO framework to guide the formulation of the review question and inform the search strategy.

Inclusion criteria were as follows:

- Studies involving individuals living or residing in Australia.
- Studies reporting the prevalence of diabetes and/or prediabetes in the general Australian population.
- Studies that reported prevalence data disaggregated by ethnic group.
- Eligible study designs included cross-sectional studies (prospective or retrospective), non-randomized controlled trials (NRCTs), cohort studies (baseline data only), case-control studies, and observational studies conducted in community, population, institutional, or hospital settings.
- Studies that explicitly reported prevalence or provided sufficient data to calculate prevalence.
- Peer-reviewed articles published in English between January 2010 and August 2024.
- Full-text articles were prioritized; however, peer-reviewed abstracts containing the necessary data were included when full texts were unavailable.

Exclusion criteria included:

- Studies involving Australian populations residing outside of Australia.
- Studies focused exclusively on pregnant women or individuals under the age of 18 years.
- Studies that did not report separate prevalence estimates for participants 18 years and above.
- Review articles, reports, letters to the editor, perspectives, case series, and case reports.
- Articles lacking data necessary to estimate prevalence.
- Observational studies that did not clearly define the study population, ethnicity, or did not report prevalence estimates by ethnic group.

### Study selection process

The study selection process was done using Covidence, starting with the importation of all studies that met the eligibility criteria to remove duplicates and manage references effectively. Three authors (N.E.E, U.L.O and A.D) independently screened the titles and abstracts to determine eligibility based on the established inclusion and exclusion criteria. Subsequently, the full texts of eligible articles were reviewed by the same authors for further evaluation. Any disagreements were resolved with the involvement of a third reviewer (K.E.A).

### Data extraction

N.E.E did the data extraction and was then independently verified by two authors, U.L.O and K.E.A. A standardized data extraction format was employed in Covidence, which included the following information: lead author's surname, year of publication, sample size, age or age group, ethnicity (considering immigration/migrant status, Indigenous status, and country of origin), methods used for diagnosing diabetes and prediabetes, diagnostic criteria, study location, and prevalence rates stratified by ethnicity. Ethnicity was categorized according to the definitions provided by the authors of the studies and aligned with the World Bank's regional classifications. The ethnic groups included Indigenous (Torres Strait Islanders, Aboriginals, First Nations), White/People of European descent (Europeans, White Australia-born, and North Americans), Asians (Indian, Bangladeshi, Chinese, Japanese, Filipino, etc.), Middle Eastern and North African (Egyptians, Syrians, Turkish), South and Central American (Mexicans, Brazilians, Chileans, Peruvians etc.), Africa origins (Sub-Sahara Africans, Black or African Americans, Afro Caribbeans), and Pacific peoples (Samoa, Tuvalu, Vanuatu). In cases where studies reported multiple ethnicities without specific data for each group, the predominant ethnicity (representing at least 80% of the participants) was used for classification.

Discrepancies between reviewers were resolved through mutual consensus. Studies were selected for analysis after confirming they met the inclusion criteria from online sources. Following data extraction, the Excel sheet from Covidence was downloaded and cleaned for further analysis.

### Quality assessment

Two independent reviewers (N.E.E and U.L.O) assessed the risk of bias for the included studies. The Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Analytical Cross-sectional Studies and the JBI Critical Appraisal Checklist for Cohort Studies were used to evaluate the methodological quality and risk of bias of the included studies. The former consists of 8 items, while the latter includes 11 items, each with four response options (yes, no, unclear, and not applicable). Discussions were held among the authors to clarify the scoring system and determine the appropriate cut-off points, which were agreed upon in a collaborative meeting before the critical appraisal process began. Each item was scored as 1 if the response was "yes," and 0 if the response was "no," "unclear," or "not applicable." The total score obtained for each study was presented as a percentage, and studies were categorized into different levels of risk of bias as follows: < 49% was classified as "high risk of bias," 50–79% as "moderate risk of bias," and > 80% as "low risk of bias."

### Statistical methods

The prevalence rates of diabetes and prediabetes were examined and analysed using STATA software version 17. The 'metaprop' command in Stata was used to calculate the pooled prevalence for both conditions. Statistical heterogeneity across studies was assessed using Cochran's Q-statistic and the  $I^2$  statistic, with heterogeneity categorized as high ( $I^2 \geq 75\%$ ), moderate ( $I^2 \geq 50\%$ ), or low ( $I^2 \geq 25\%$ ). To evaluate potential publication bias, both a funnel plot and Egger's test were utilized (see supplementary figures). Additionally, 'metapreg' command in STATA was used to examine the relationship between the method of diagnosis, Indigenous status, ethnicity and the year of publication, which was assessed through a meta-regression analysis.

## Results

### Description of studies

The database search yielded 2838 results, of which 1970 were duplicates. After removing the duplicates, titles, and abstracts of 879 studies were screened. A total of 764 studies were excluded because they did not meet the eligibility criteria. Of the remaining 113 studies that underwent full-text screening, only 27 were included in the systematic review and meta-analysis. The details of

the study selection process are presented in the PRISMA flowchart (Fig. 1).

## Systematic review of selected studies

### Characteristics of the included study

Table 2 presents the study characteristics of the reviewed papers. All 27 studies included in the review were cross-sectional studies conducted across various regions of Australia. Six studies [21–26] were conducted in New South Wales, four in Central Australia [27–30], five in Western Australia [31–35], four in Queensland [36–39] and two in Northern Territory [1, 40]. One study each was conducted in Victoria [41] and South Australia [42]. Other studies [43–46] provided national-level data and there were no studies specifically reporting on the prevalence of diabetes and prediabetes in Tasmania and the Australian Capital Territory (ACT).

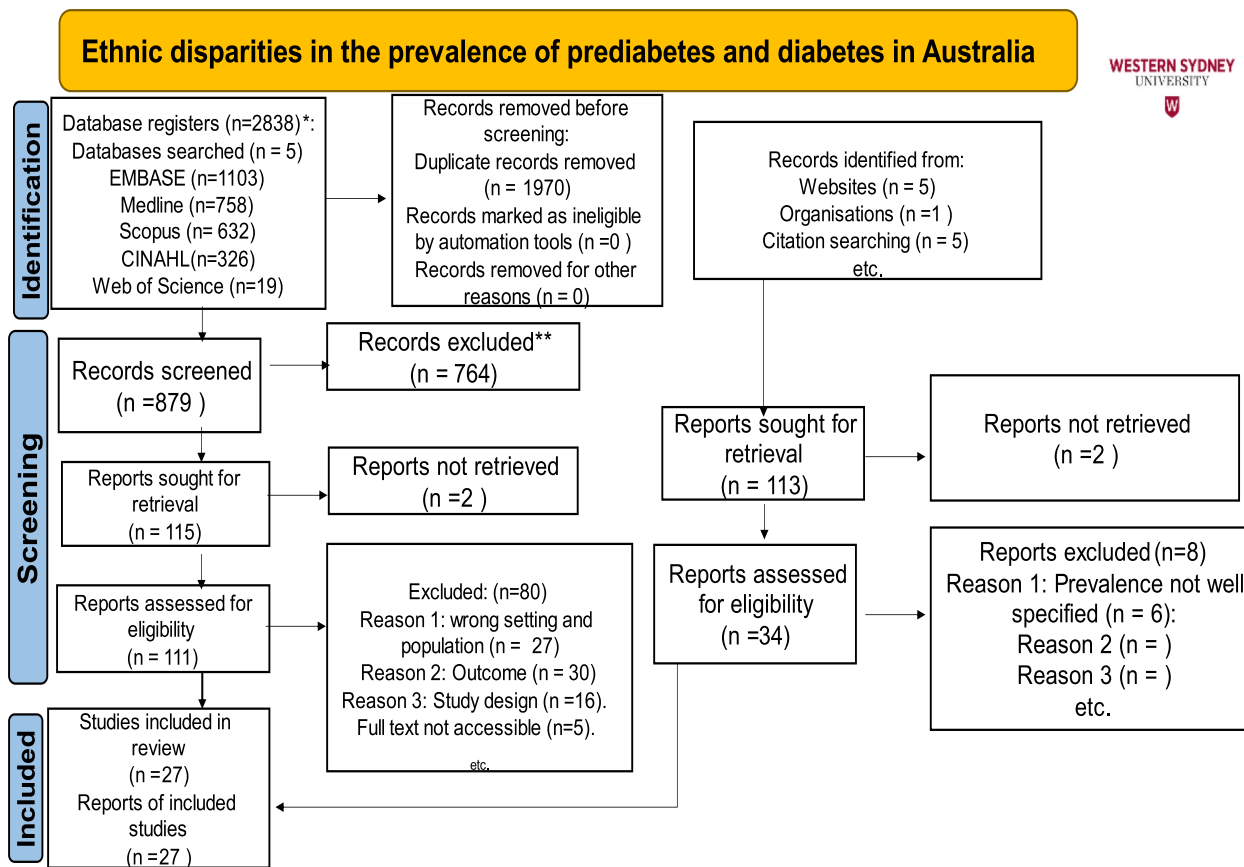
While all 27 studies reported the prevalence of diabetes, only six studies [1, 26, 32, 33, 39, 40] reported the prevalence of prediabetes. Fourteen studies [1, 27–36, 40, 43, 46] focused on First Nations people, and seven studies included White/People of European descent [21, 22, 24, 26, 42, 44, 45]. Five studies [21, 25, 26, 44, 45] investigated Oceania populations, four studies [26, 37, 38, 41] included populations from Sub-Saharan Africa, and only one study [26] included America (Hispanic or Central and South America) populations. Fifteen studies [21, 22, 24, 26–28, 30, 32, 33, 35, 39, 42–45] focused exclusively on individuals aged 40 years and older and 12 studies [21, 22, 24, 27, 30, 35, 37, 39, 42–45] diagnosed diabetes solely based on self-report. The age range of the study sample population was 18 to 85 years. Our study involved a total of 1,137,925 reported participants with the sample size of included studies ranging from 50 to 266,848.

### Meta-analysis of prediabetes and diabetes prevalence

#### Prevalence of diabetes

Figure 2 presents a forest plot of the pooled estimated prevalence of diabetes across different ethnic groups in Australia. The pooled prevalence of diabetes was 21.8% (95% CI: 20.60–23.01), with high heterogeneity ( $I^2 = 99.9\%$ ). The prevalence of diabetes was highest among Pacific peoples (36.5%, 95% CI: 15.20–57.86), followed by Indigenous Australians (25.3%, 95% CI: 17.87–32.71), and lowest among White/People of European descent (14.5%, 95% CI: 13.03–16.01). Meta-regression analysis showed a significant variation in the weighted prevalence of diabetes across ethnic groups, with an overall  $p$ -value < 0.001.

Figure 3 presents the forest plot of the pooled estimated prevalence of diabetes based on indigeneity. The pooled estimated prevalence of diabetes was 22.0% (95% CI: 20.83–23.24), with high heterogeneity ( $I^2 = 99.9\%$ ). The prevalence of diabetes was higher among Indigenous



**Fig. 1** PRISMA Flow chart of ethnic disparities in the prevalence of prediabetes and diabetes in Australia

Australians (30.7%, 95% CI: 23.90–37.49) compared to non-Indigenous Australians (18.6%, 95% CI: 17.29–19.97). The Likelihood Ratio (LR) test statistic for the interaction of Indigeneity (Indigenous vs. non-Indigenous) by year confirmed that the weighted prevalence of diabetes varies significantly over time ( $\chi^2 = 517.2, p < 0.001$ ).

Figure 4 presents the forest plot of the pooled estimated prevalence of diabetes based on the method of diagnosis. The pooled estimated prevalence of diabetes was 22.0% (95% CI: 20.83–23.24), with high heterogeneity ( $I^2 = 99.2\%$ ). The prevalence of self-reported diabetes (21.7%, 95% CI: 20.19–23.15) was lower than the prevalence identified through diagnostic methods (23.3%, 95% CI: 18.32–28.35). The Likelihood Ratio (LR) test statistic for the interaction between diagnostic method (Diagnostic vs. Self-Reported) and year revealed a significant variation in the weighted prevalence of diabetes over time ( $\chi^2 = 730.6, p < 0.001$ ).

**Prevalence of prediabetes**

Figure 5 presents the forest plot of the pooled estimated prevalence of prediabetes across various ethnic groups in Australia. The prevalence of prediabetes across different ethnic groups ranged between 0.6% and 39.8% over the

years, with the highest rates observed in 2018, followed by 2024 and 2022. The pooled prevalence of prediabetes is 13.7% (95% CI: 10.42–17.02), with statistically significant heterogeneity ( $I^2 = 99.5\%, p < 0.001$ ).

Among Indigenous Australians, the prevalence of diabetes ranged from 2.6% to 39.8% over the years, with the highest recorded in 2018, followed by 2010 and 2019. In contrast, the prevalence of prediabetes among non-Indigenous Australians ranged from 0.6% to 38.0%, with the highest prevalence recorded in 2024. The prevalence of prediabetes was higher among Indigenous Australians (17.7%, 95% CI: 11.12–24.34) compared to non-Indigenous Australians (11.0%, 95% CI: 7.87–14.13). Meta-regression analysis revealed a significant difference in the weighted prevalence of prediabetes based on indigeneity, with a  $p$ -value  $< 0.001$  (Fig. 6).

**Discussion**

The Australian population is culturally diverse due to international migration. There is evidence of disparities in the prevalence of diabetes and prediabetes across different populations. To the best of our knowledge, this study is the first to estimate the pooled prevalence of prediabetes and diabetes among various ethnic groups in Australia. Our findings indicate significant disparities in



**Table 2** Characteristics of included studies

Authors and year of study	Year of study	Age group (years)	Total sample size	Ethnicity included	Location	Method diagnosis	Type of study	Sex distribution	Limitations	QA
Hoy et al. [31]	2010	≥ 18	1,070	First nations	Western Australia	Diagnostic method	Cross sectional	NR	Use of hospital record	60
Wang et al. [40]	2010	20–74	686	First nations	Northern Territory	Diagnostic method	Cross sectional	NR	Use of hospital records	60
McDermott et al. [36]	2010	≥ 18	554	First nations	Queensland	Diagnostic method	Cross sectional	M=274 F=280	Sample size	60
Landers et al. [27]	2010	≥ 40	1884	First nations	Central Australia	Self-report	Cross sectional	M=689 F=1195	Use of self-report	60
Xie et al. [43]	2011	≥ 40	1189	First nations	National	Self-report	Cross sectional	NR	Use of self-report	
Renzaho et al. [41]	2011	≥ 20	50	Sub-Sahara Africa	Victoria	Diagnostic method	Cross sectional	NR	Sample size	55
Einsiedel et al. [28]	2013	≥ 45	558	First nations	Central Australia	Diagnostic method	Cross sectional	NR	Use of hospital records	70
Shamshirgaran et al. [21]	2013	≥ 45	266,848	Australian and non-Australian born	New South Wales	Self-report	Cross sectional prospective	NR	Not assessing cultural and environmental factors	75
Tran et al. [47]	2014	≥ 45	196,866	Australian and non-Australian born	New South Wales	Self-report	Cross sectional	NR	Use of self-report	65
Gador-Whyte et al. [29]	2014	≥ 18	297	First nations	Central Australia	Diagnostic method	Cross sectional	NR	Sample size	70
Renzaho et al. [37]	2014	18–70	314	Sub-Sahara Africa	Queensland	Self-report	Cross sectional	NR	Use of self-report	65
Fernandez et al. [23]	2015	18–80	169	Asians	New South Wales	Diagnostic method	Cross sectional prospective	NR	Sample size	75
Guo et al. [24]	2015	≥ 45	263,356	Australia born and non-Australia born	New South Wales	Self-report	Cross sectional prosp	NR	Low response rate	75
Hyde et al. [32]	2016	≥ 45	182	First nations	Western Australia	Self-report	Cross sectional	NR	Not including other ethnic groups	65
Keel et al. (2017) [44]	2017	40–92	3098	White/People of European descent	National	Self-report	Cross sectional	NR	Use of self-report	75
Hyde et al. [32]	2018	≥ 45	289	First nations	Western Australia	Diagnostic method				NR
Taylor et al. [42]	2018	40–59	547	White/People of European descent	South Australia	Self-report	Cross sectional	NR	Use of self-report	65
Hussain et al. [34]	2018	25–59	2106	First nations	Western Australia	Diagnostic method	Cross sectional	NR	Use of hospital record	60
Hyde et al. [33]	2019	≥ 45	289	First nations	Western Australia	Diagnostic method	Cross sectional	NR	Sample size	70
Foreman et al. [45]	2020	≥ 40	3098	White/People of European descent	National	Self-report	Cross sectional	NR	Use of self-report	80
Ndwiga et al. [25]	2020	≥ 18	131	Pacific peoples	New South Wales	Diagnostic method	Cross sectional	NR	Use of hospital records	75
Bilal et al. [38]	2021	≥ 18	170	Sub-Saharan African migrants	Queensland	Diagnostic method	Cross sectional	NR	Sample size	75
Nisar et al. [39]	2021	40–45	11,035	low middle income country immigrants	Queensland	Self-report	Cross sectional	M=4942 F=6093	Use of self report	
Hare et al. [1]	2022	≥ 18	21,267	First nations	Northern Territory	Diagnostic method	Cross sectional retros	M=10,365 F=10,902	Use of hospital records	75

**Table 2** (continued)

Authors and year of study	Year of study	Age group (years)	Total sample size	Ethnicity included	Location	Method diagnosis	Type of study	Sex distribution	Limitations	QA
Pink et al. [46]	2023	≥ 18	29,429	First nations	National	Diagnostic method	Cross sectional	M = 11,656 F = 17,773	Use of hospital records	75
Serrano et al. [26]	2024	≥ 40	510	Asians and America	New South Wales	Diagnostic method	Retrospective cross-sec	NR	Sample size	80
Rajamohan et al. [30]	2024	≥ 40	293	First nations	Central Australia	Self-report	Cross sectional	NR	Use of single centre and self-report	80

Diagnostic method: hospital records or diabetes screening or tests. America: Central and South America

the prevalence of these conditions across different ethnic groups, with Pacific peoples and Indigenous Australians exhibiting the highest prevalence rates, while White/People of European descent the least affected. Our systematic review and meta-analysis offer crucial insights into the burden of prediabetes and diabetes within diverse populations, revealing a pooled prevalence of 13.7% for prediabetes and 21.8% for diabetes. These findings underscore a major public health concern, as both prediabetes and diabetes are associated with increased risks of adverse health outcomes, including cardiovascular disease, kidney failure, and neurological complications.

The high pooled prevalence of diabetes observed in this study aligns with the global trend of increasing diabetes prevalence across diverse ethnic populations. [6, 14, 48, 49]. The observed differences in prevalence rates across ethnic groups could be attributed to a combination of social, environmental, and genetic factors [2, 19]. Furthermore, disparities between populations may stem from varying national contextual factors. For instance, different ethnic groups may experience different socio-economic conditions compared to their countries of origin, or they may undergo dietary changes following migration that can affect their health outcomes differently across ethnic groups [2]. A study conducted in the USA [14] found that Chinese people living in China reported lower energy intake from carbohydrates and engaged in more physical activity compared to their counterparts residing in the United States. Also, a study in Europe reported high prevalence of type-2 diabetes among Africans living in Europe than those living in Africa [19]. In addition, early type 2-diabetes onset was also reported to be high among migrants from Africa than Africans living in Africa [2, 50]. These findings may also be applicable in the Australian context. Future research in Australia should focus on addressing the underlying factors contributing to these ethnic disparities, with particular emphasis on the roles of lifestyle, healthcare access and utilization, change of environment, social exclusion, cultural barriers, and genetic predispositions.

Moreover, the prevalence of diabetes observed in this study is notably higher than what was reported by the International Diabetes Federation (IDF) for various

geographical regions [14]. It was also higher than 12.4% recorded among immigrants in a study in Italy [50]. Moreover, while the highest prevalence of diabetes in our study was observed among Pacific peoples, the IDF reported highest prevalence among populations from the Middle East and North Africa (MENA). Also, a study in Europe reported the highest prevalence among Asians than other ethnic groups [49]. These differences in prevalence rates emphasize the need for targeted interventions aimed at reducing the incidence of diabetes, particularly among high-risk ethnic groups.

The lower prevalence of diabetes reported among White/People of European descent in this study is consistent with previous findings, as they are known to have a lower risk of diabetes due to reductions in diabetes precursors such as HbA1c, insulin, triacylglycerol, and C-reactive protein levels. Similar results were reported in studies in Europe [14]. Additionally, the underrepresentation of certain ethnic groups, such as South and Central Americans, in this study mirrors findings from a study on ethnic minority groups in the United States [48] where Latin Americans and Hispanics were also underrepresented. This underrepresentation may be attributed to inadequate or inconsistent documentation of ethnic groups in records, particularly hospital records, in many countries. Moreover, ethnicity is often not reported in many epidemiological studies [2], including diabetes research in high-income countries like Australia, which complicates efforts to monitor ethnic groups at high risk.

Stratification of diabetes prevalence by diagnostic method reveals a higher prevalence of diabetes diagnosed through clinical methods (23.3%) compared to self-reported diagnoses (21.7%). This discrepancy suggests that clinical assessments may identify cases of diabetes that self-reporting misses, as self-reporting is often influenced by underreporting or a lack of awareness. Such differences in diagnostic methods can influence the reported prevalence, with clinical methods potentially providing a more accurate estimate of the true burden of diabetes and prediabetes. These findings highlight the importance of incorporating both clinical methods and self-reported data in public health surveillance to achieve a more comprehensive understanding

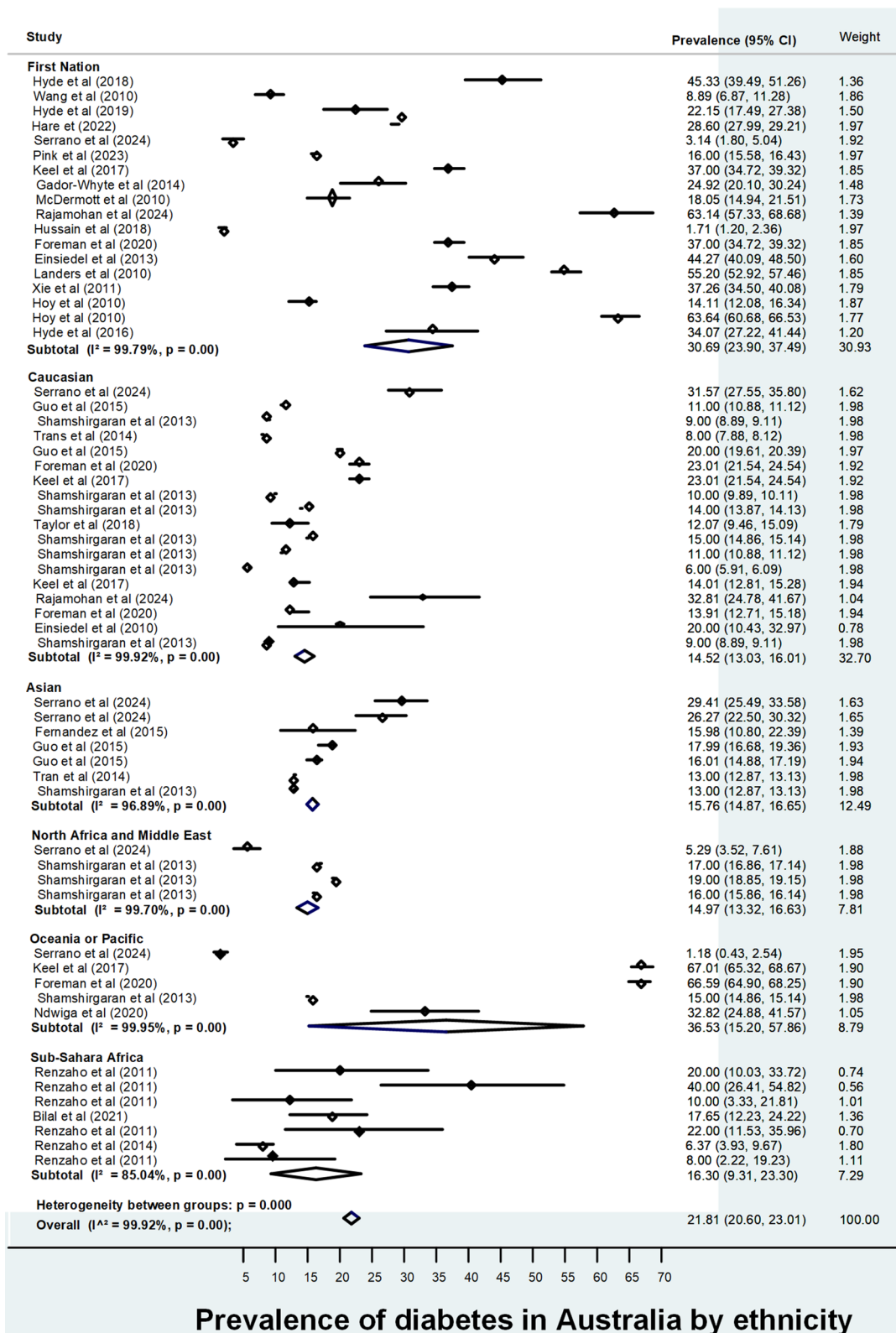


Fig. 2 Diabetes prevalence by ethnicity Forest Plot

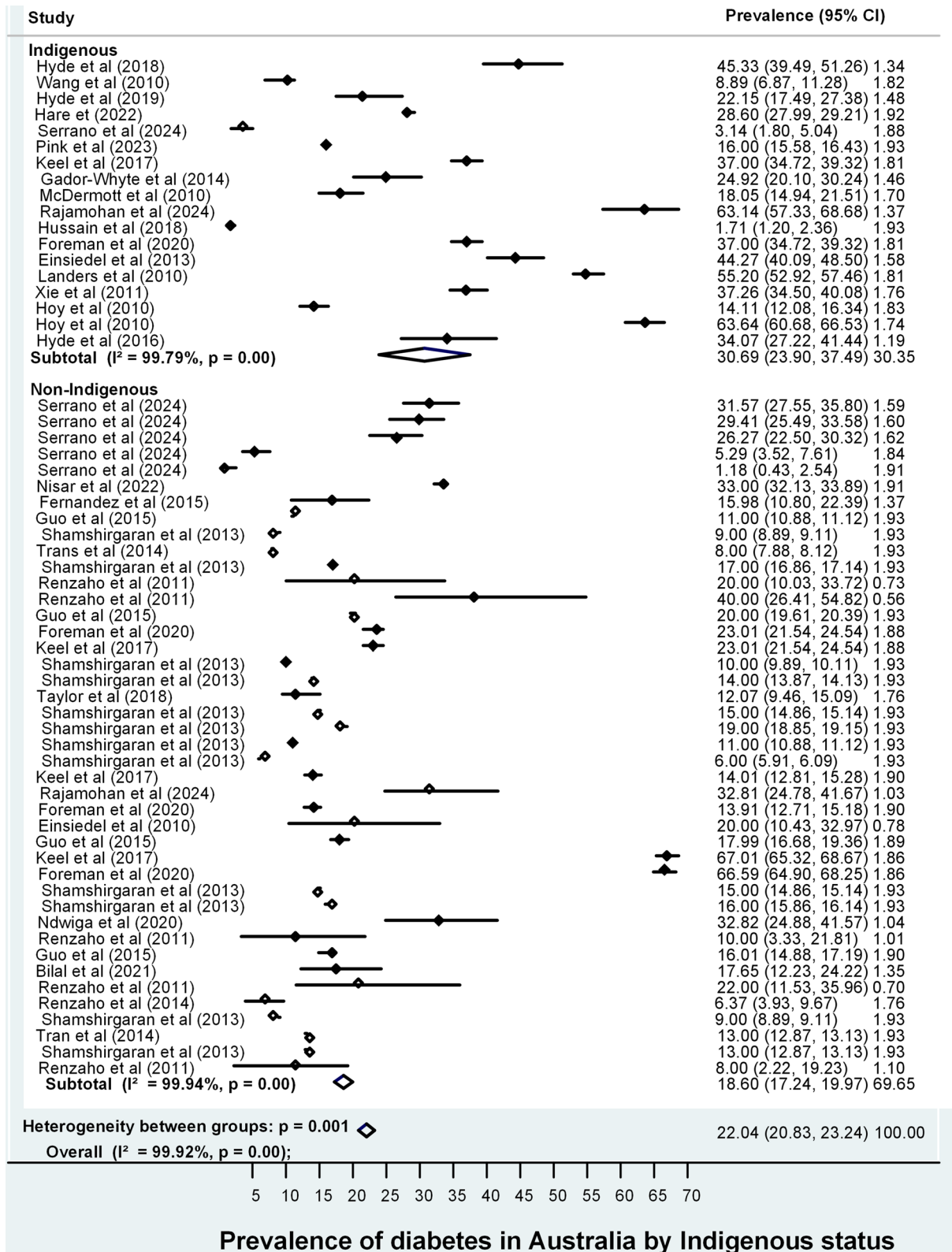


Fig. 3 Diabetes prevalence by indigeneity Forest Plot

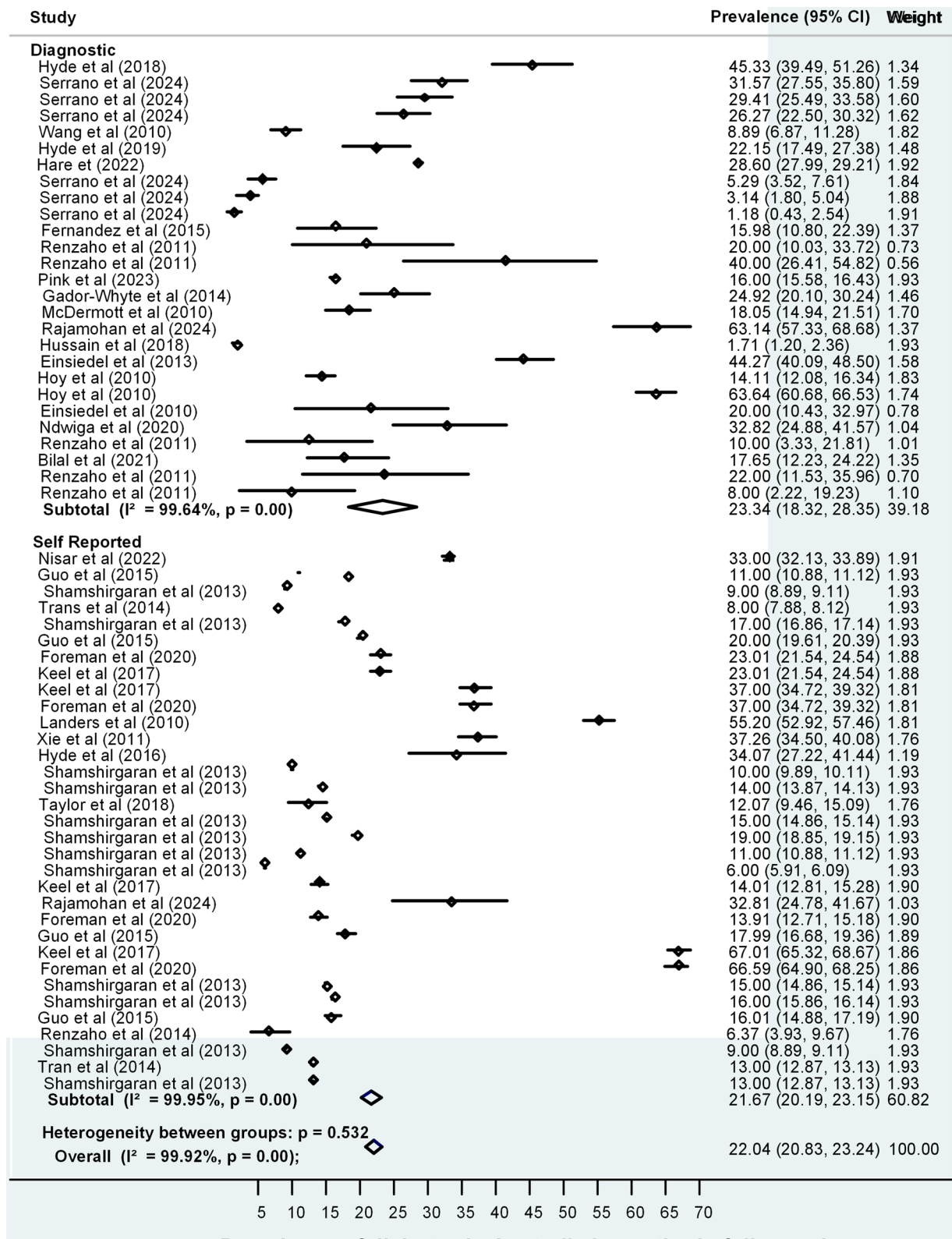
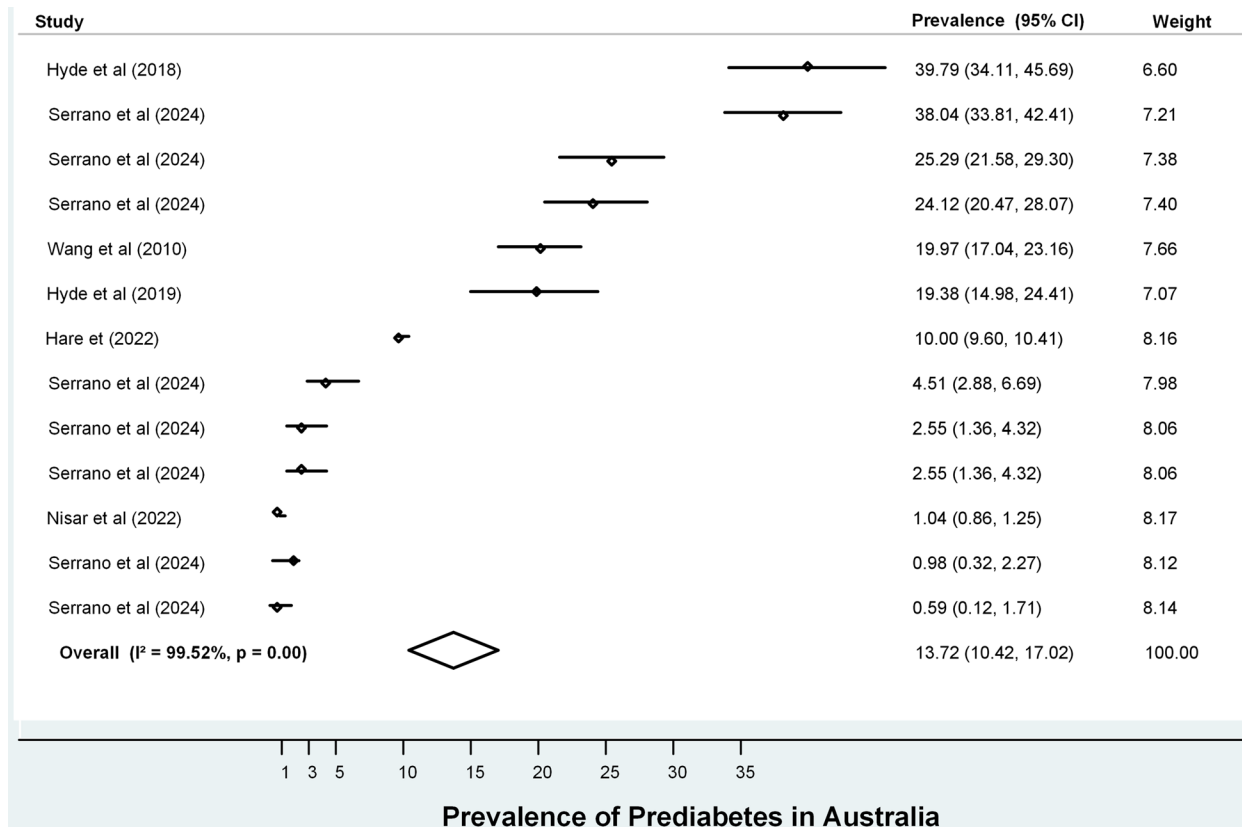


Fig. 4 Diabetes prevalence by method of diagnosis Forest Plot



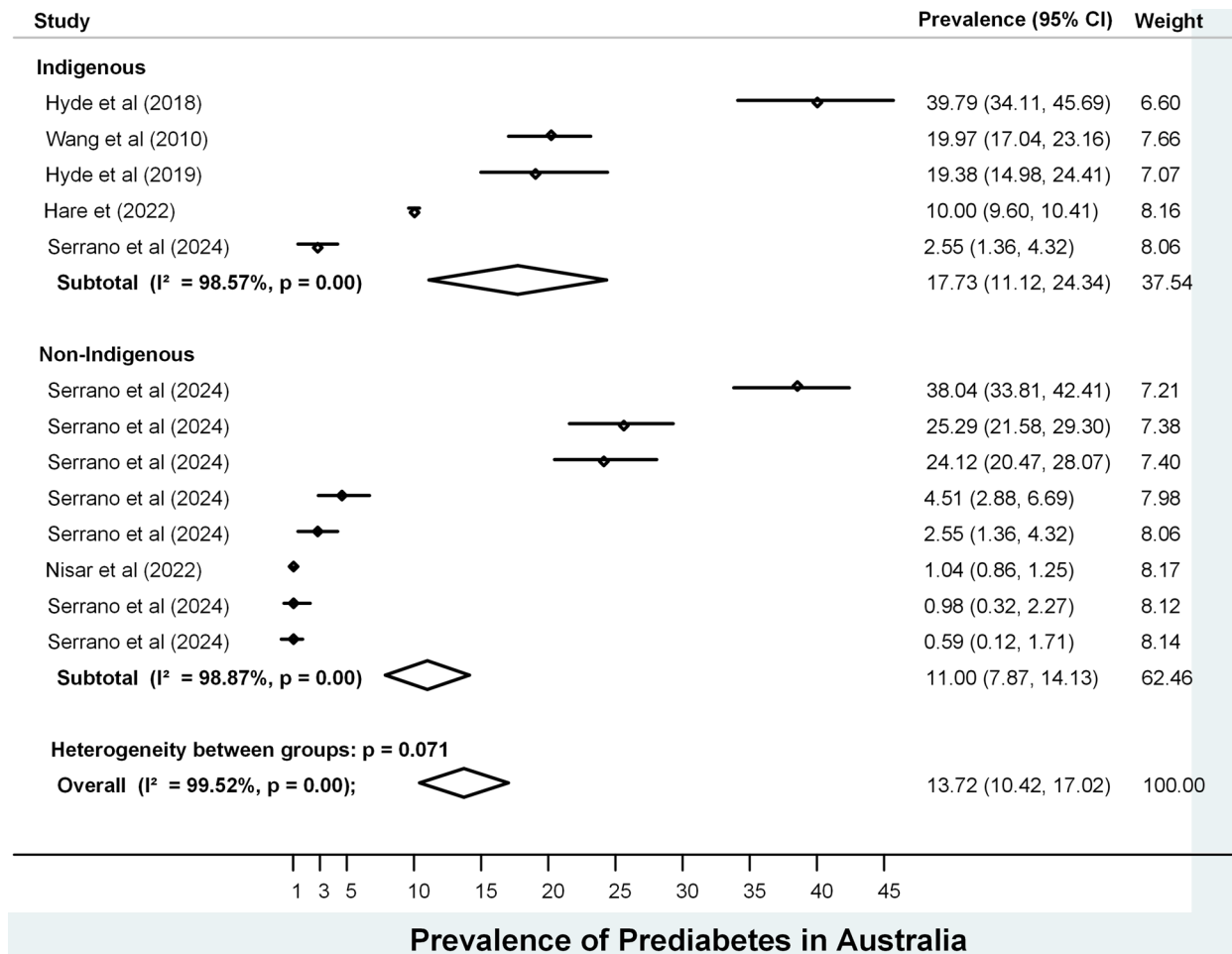
**Fig. 5** Prediabetes prevalence Forest Plot

of diabetes prevalence. Investigating the reasons behind these discrepancies could help refine screening protocols and improve early detection, leading to better-targeted interventions and management strategies within the population.

Moreover, diabetes screening practices vary by race, which can also significantly impact the reported prevalence of the condition. Studies have shown that racial and ethnic disparities in screening are influenced by factors such as awareness, perceived risk and access to healthcare services [51–54]. For instance, Blacks, Hispanics/Latinos, and First Nations populations are less likely to go for diabetes screening or have early diagnoses, good adherence to screening, and good health outcomes due to barriers like limited access to healthcare services and medical insurance [51, 52]. As a result, these populations may be underrepresented or underreported in early detection rates, leading to lower reported prevalence figures in some studies. In addition, Asian Americans were identified as the least likely group to be appropriately screened for diabetes [52]. Furthermore, the belief that certain ethnic groups are at lower risk for developing diabetes may contribute to lower screening rates, which could further underestimate diabetes prevalence in these populations. Historically, Asians were not considered at high risk for diabetes, but recent research has shown a

significant risk among this group [55]. If these populations are not appropriately screened, the true prevalence of diabetes in these communities could be significantly underreported, contributing to skewed public health data. Addressing these factors through more inclusive and accurate screening methods could provide a clearer picture of diabetes prevalence across diverse populations and improve targeted interventions.

The pooled estimated prevalence of diabetes among Indigenous people in our study was higher than the 7.9% reported by the Australian Bureau of Statistics [56]. The elevated prevalence observed in our study is consistent with findings from other studies on Indigenous populations [18, 57, 58]. The higher prevalence of diabetes among Indigenous Australians can be attributed to a complex interplay of genetic, environmental, socio-economic, and cultural factors. Studies [59, 60] showed that Indigenous Australians are more likely than non-Indigenous Australians to exhibit key risk factors for diabetes. Specifically, they are 1.2 times more likely to be overweight or obese, 1.2 times more likely to have high blood pressure, 1.8 times more likely to have abnormal high-density lipoprotein (HDL) cholesterol levels, and 1.9 times more likely to have elevated triglyceride levels [59, 60]. Furthermore, Indigenous Australians are 2.6 times more likely to smoke or take excessive alcohol



**Fig. 6** Prediabetes PR by indigeneity

compared to their non-Indigenous counterparts [59, 60]. Indigenous Australians are less likely to meet the recommended guidelines for daily fruit and vegetable intake, with adherence rates being 0.9 times and 0.8 times, respectively, when compared to non-Indigenous populations [60]. Genetic susceptibility also plays a significant role in the heightened prevalence of diabetes in Indigenous populations. Research indicates that Indigenous Australians exhibit higher fasting glucose levels, elevated insulin concentrations, and increased insulin resistance compared to other ethnic groups, which may contribute to a more pronounced metabolic dysfunction [18]. These genetic predispositions, combined with socio-economic and lifestyle factors, likely exacerbate the risk of developing diabetes and its related complications within this population. These findings highlight the need for targeted public health interventions and policies to address the higher prevalence of diabetes among Indigenous populations. Given the contributing factors such as elevated fasting glucose and insulin resistance, tailored strategies focusing on prevention, early detection, and management of diabetes are essential. Further research is required to

explore the underlying genetic, socio-economic, and lifestyle factors contributing to this disparity, and to identify effective interventions to improve health outcomes for Indigenous communities. Addressing these challenges will be critical to reducing the diabetes burden and promoting equitable healthcare access.

Conversely, the high prevalence of diabetes among Pacific peoples can be largely attributed to their genetic susceptibility to the effects of a "Western" diet and lifestyle, both of which are strongly associated with an increased risk of developing diabetes. The transition to a Westernized diet, characterized by high intake of processed foods, sugars, and unhealthy fats, has significantly contributed to the rise in diabetes rates within this population [61]. Additionally, Pacific peoples are reported to have one of the highest rates of obesity globally, a condition closely linked to the development of type 2 diabetes [62]. This high prevalence of obesity is partly attributed to lower levels of physical activity, further exacerbating the risk of metabolic disorders, including diabetes [61].

The estimated prevalence of prediabetes in our study was comparable to the 13.9% reported in a similar study

conducted in Europe [49]. However, It was higher than findings from a global systematic review [6]. This discrepancy may be attributed to methodological differences, regional health disparities, or variations in the healthcare systems between Australia and other parts of the world. The limited number of studies in Australia that reported ethnic-specific prevalence data for prediabetes, as found in this study, aligns with findings from a global systematic review on prediabetes prevalence [6] where 60% of studies did not report prediabetes prevalence. Reporting the prevalence of prediabetes is essential for understanding the full scope of the diabetes-related health challenge, facilitating early intervention, and promoting preventative measures that can reduce the burden of diabetes in the population.

Additionally, the lack of consistent classification of prediabetes types in many studies [1, 26, 32, 33, 63, 64] further limited the ability to make direct comparisons with global findings. Classifying prediabetes based on its types is essential for precise clinical management, improving prevention strategies, understanding disease mechanisms, and enhancing public health efforts. This approach ensures that interventions are better tailored to individual needs, ultimately reducing the risk of progression to type 2 diabetes and associated complications.

### Strengths and limitations

The study presents several key strengths that contribute to a deeper understanding of ethnic disparities in diabetes and prediabetes prevalence in Australia. First, this is the first systematic review on the prevalence of diabetes and prediabetes across various ethnic groups within the country. By including all ethnic groups in Australia, the meta-analysis ensures broad and inclusive representation, capturing the experiences of diverse communities. Additionally, the use of multiple databases in our search process further strengthens the review, enabling the identification of a wide range of studies and providing a comprehensive understanding of the prevalence differences across ethnic groups.

Additionally, the study highlights significant gaps in the existing literature on diabetes and prediabetes in Australia, providing valuable insights to guide future research directions. By addressing these gaps, future studies can ensure that all ethnic groups are adequately represented and considered in diabetes research. Furthermore, the meta-analysis synthesizes the available data, offering high-quality, reliable evidence that can inform healthcare providers, policymakers, and researchers. This evidence is crucial for addressing the systemic health inequities that contribute to higher rates of diabetes and prediabetes among certain ethnic populations, ultimately supporting the development of more effective, targeted public health interventions. The findings from this review

can also support the development of culturally tailored prevention programs and interventions, designed to address the specific needs of Australia's diverse ethnic and migrant communities, ultimately working to reduce health disparities and improve diabetes outcomes.

However, several notable limitations must be acknowledged. Firstly, there was a high degree of between-study heterogeneity, which suggests that the pooled prevalence estimates should be interpreted with caution. Additionally, many ethnic groups were underrepresented, which limits the ability to determine a truly representative overall prevalence rate. Furthermore, only a few studies provided specific data on the prevalence of prediabetes by ethnicity, and most studies did not report on the specific types of prediabetes. The age groups assessed were also unevenly distributed across different ethnic populations, and none of the studies reported a specific average age for the prevalence of diabetes and prediabetes.

Despite our study limitations, our study findings provide valuable insights that contribute to the growing body of evidence regarding ethnic disparities in prediabetes and diabetes prevalence. Our research emphasizes the critical need to incorporate ethnicity as a factor in the assessment, prevention, and management of prediabetes and diabetes. Furthermore, the study highlights significant gaps in diabetes research including methodologies, particularly regarding diagnostic approaches, age group stratification, sample size, sampling techniques, and overall study design. Addressing these issues is essential for minimizing publication bias, improving statistical power, and ensuring more accurate and meaningful interpretation of research findings. Ultimately, enhancing these aspects of diabetes research will facilitate more effective public health strategies and interventions aimed at reducing the burden of these conditions across diverse populations in Australia.

### Conclusion

Approximately one in five individuals in Australia have diabetes, while one in six are affected by prediabetes. However, these figures show significant variation across ethnic groups. Diabetes prevalence is highest among Pacific peoples and Indigenous Australians, while it is lowest among White/People of European descent. This substantial heterogeneity underscores the need for more comprehensive, population-based studies to better understand the underlying causes of these disparities. The implications for public health are far-reaching, as these disparities suggest that certain ethnic groups are at a high risk of diabetes and related complications. Health policies should prioritize tailored interventions for at-risk populations, particularly Indigenous Australians and Pacific peoples, to reduce the burden of diabetes. Clinicians should be aware of these ethnic differences

and incorporate them into their patient assessments and treatment plans, ensuring culturally competent care. Future studies should focus on exploring the genetic, environmental, and socioeconomic factors that contribute to these ethnic disparities in diabetes prevalence. Longitudinal studies that track the progression from prediabetes to diabetes in different ethnic groups are essential to identify effective prevention strategies. Furthermore, studies examining the effectiveness of culturally targeted public health programs and clinical interventions in reducing the prevalence of diabetes among at-risk populations are also warranted.

### Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12889-025-23689-x>.

Supplementary Material 1. S1. funnel plots and 95% confidence intervals of Diabetes. S2. A regression analysis of diabetes by year of publication. S3. funnel plots and 95% confidence intervals of Prediabetes. S4. A regression analysis of prediabetes by year of publication.

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### Authors' contributions

N.E.E: Writing—original draft; N.E.E: writing—review and editing; U.L.O, K.E.A and A.D: Supervision; N.E.E, U.L.O and K.E.A: Data curation, resources and analysis. A.A and U.L.O: Writing—original draft; N.E.E, U.L.O, K.E.A and A.D: writing—review and editing; U.L.O, K.E.A and A.D: Supervision; N.E.E, U.L.O and K.E.A: Data curation, resources and analysis.

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### Data availability

The data used to support the findings of this study are made available from the corresponding author upon reasonable request.

### Declarations

#### Ethical approval and consent to participate

Not applicable.

#### Consent for publication

Not applicable.

#### Competing interests

The authors declare no competing interests.

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